



MLR Institute of Technology

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FRESHMAN ENGINEERING

QUESTION BANK

Course Name : MATHEMATICS – I
Course Code : A10002
Class : I - B. Tech
Branch : Common for all Branches
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OBJECTIVES

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of MLR Institute of Technology, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner’s learning process.

1. Group - A (Short Answer Questions)

S. No	Question	Blooms Taxonomy Level	Course Outcome
UNIT-I THEORY OF MATRICES			
1	Find the eigen values of the matrix $\begin{bmatrix} 4 & 1-3i \\ 1+3i & 7 \end{bmatrix}$	Evaluate	a
2	If A is Hermitian matrix Prove that iA is skew- Hermitian matrix	Analyze	a
3	State Cayley- Hamilton Theorem	Remember	b
4	Prove that $\frac{1}{2} \begin{bmatrix} 1+i & -1+i \\ 1+i & 1-i \end{bmatrix}$ is a unitary matrix.	Understand	a
5	Find the value of k such that rank of $\begin{bmatrix} 1 & 2 & 3 \\ 2 & k & 7 \\ 3 & 6 & 10 \end{bmatrix}$ is 2.	Evaluate	a

S. No	Question	Blooms Taxonomy Level	Course Outcome
6	Find the eigen values of the matrix $\begin{bmatrix} 2 & 3+4i \\ 3-4i & 2 \end{bmatrix}$	Evaluate	b
7	Find A^θ if $A = \begin{bmatrix} 1+i & 3 \\ 2-i & 4+2i \end{bmatrix}$	Evaluate	a
8	Define modal matrix.	Remember	c
9	Find the Skew- symmetric part of the matrix $\begin{bmatrix} 1 & 1 & 2 \\ -1 & 1 & 1 \\ 3 & -1 & 2 \end{bmatrix}$	Evaluate	a
10	If 2, 3, 4 are the eigen values of A then find the eigen values of adj A	Evaluate	a
UNIT-II			
DIFFERENTIAL CALCULUS METHODS			
1	Define Rolle's Mean value theorem.	Remember	a
2	Verify Lagrange's Mean Value theorem for $f(x) = \log x$ in $[1, e]$	Analyze	e
3	Verify Lagrange's Mean Value theorem for function $f(x) = \cos x$ in $[0, \pi/2]$.	Analyze	e
4	Verify Cauchy's Mean Value theorem for $f(x)=x^2, g(x)=x^3$ in $[1, 2]$.	Analyze	e
5	Find first and second order partial derivatives of $ax^2+2hxy+by^2$ and verify $\frac{\partial^2 f}{\partial x \partial y} = \frac{\partial^2 f}{\partial y \partial x}$.	Evaluate	f
6	When two functions u,v of independent variables x,y are functionally dependent	Understand	f
7	If $x = u(1-v), y = uv$ prove that $JJ^1 = 1$	Understand	g
8	Find the maximum and minimum values of $x^3 + y^3 - 3axy$	Remember	g
9	If $u = e^x \sin y, v = e^x \cos y$ then find $\frac{\partial(u,v)}{\partial(x,y)}$	Evaluate	e
10	Verify Rolle's Mean value theorem for $f(x)=(x+2)^3(x-3)^4$ in $[-2,3]$	Remember	e
UNIT-III			
IMPROPER INTEGRALS, MULTIPLE INTEGRALS AND ITS APPLICATIONS			
1	Prove that $\beta(m,n) = \beta(n,m)$.	Understand	h

S. No	Question	Blooms Taxonomy Level	Course Outcome
2	Prove that $\int_0^a (a-x)^{m-1} x^{n-1} dx = (a-b)^{m+n-1} \beta(m,n), m > 0, n > 0$	Understand	h
3	Compute $\Gamma(11/2), \Gamma(1/2), \Gamma(-7/2)$	Evaluate	h
4	Write the value of $\Gamma(1)$.	Analyze	h
5	Evaluate $\int_0^2 \int_0^x y dy dx$	Evaluate	i
6	Evaluate $\int_0^\pi \int_0^{a \sin \theta} r dr d\theta$.	Evaluate	i
7	Evaluate $\int_0^3 \int_0^1 xy(x+y) dx dy$.	Evaluate	i
8	Evaluate $\int_1^e \int_1^{\log y} \int_2^{e^x} \log z dx dy dz$.	Evaluate	j
9	find the value of $\int_{-1}^1 \int_{-2}^2 \int_{-3}^3 dx dy dz$.	Analyze	j
10	Write the spherical polar coordinates	Remember	j
UNIT-1V DIFFERENTIAL EQUATIONS AND APPLICATIONS			
1	Solve $(x+1)dy/dx - y = e^{3x} (x+1)^2$	Evaluate	k
2	Write the working rule to find orthogonal trajectory in Cartesian form.	Understand	k
3	Form the D.E. by eliminating c in $y=1+c \sqrt{1-x^2}$	Analyze	l
4	Solve $(x+y+1) dy/dx = 1$	Evaluate	l
5	Prove that the system of parabolas $y^2 = 4a(x+a)$ is self orthogonal.	Analyze	k
6	Find the O.T. of the family of curves $r^n = a^n \cos n\theta$	Evaluate	k
7	State Newton's law of cooling	Remember	f
8	A bacterial culture, growing exponentially, increases from 200 to 500 grams in the period from 6 a.m to 9 a.m. . How many grams will be present at noon.	Analyze	f
9	Solve $y''' - 3y' + 2y = 0$	Evaluate	k
10	Define S.H.M. and give its D.E	Remember	l
UNIT-V LAPLACE TRANSFORMS AND ITS APPLICATIONS			
1	Find Laplace transform of $\frac{e^{-at} - 1}{a}$	Evaluate	m
2	State first shifting theorem.	Understand	n
3	Write change of scale property of Laplace Transform	Remember	n
4	Find $L(t \sin 3t \cos 2t)$	Apply	m
5	If $f(t)$ is periodic function with period T then write $L\{f(t)\}$	Remember	m
6	Find $L(\cosh^2 2t)$	Apply	m
7	Find $L\{e^{-3t}(2\cos 5t - 3\sin 5t)\}$	Apply	m

S. No	Question	Blooms Taxonomy Level	Course Outcome
8	Find the inverse Laplace transform of $\frac{4}{(s+1)(s+2)}$	Evaluate	n
9	Define inverse L.T. of f(s)	Remember	m
10	Use L.T to solve D.E. $y'' + y = 0, y = 1, y' = 0$ when t = 0	Remember	o

2. Group - B (Long Answer Questions)

S. No	Question	Blooms Taxonomy Level	Course Outcome
UNIT-I			
THEORY OF MATRICES			
1	Show that only real number λ for which the system $x+2y+3z = \lambda x$, $3x+y+2z = \lambda y$, $2x+3y+z = \lambda z$ has non-zero solution is 6 and solve them when $\lambda = 6$	Analyze	a
2	Express the matrix $\begin{bmatrix} 1+i & 2 & 5-5i \\ 2i & 2+i & 4+2i \\ -1+i & -4 & 7 \end{bmatrix}$ as the sum of Hermitian matrix and skew- Hermitian matrix.	Analyze	a
3	Given that $A = \begin{bmatrix} 0 & 1+2i \\ -1+2i & 0 \end{bmatrix}$ show that $(I - A)(I + A)^{-1}$ is unitary matrix.	Create	a
4	Find rank by reducing to Normal form of matrix $\begin{bmatrix} 2 & -2 & 0 & 6 \\ 4 & 2 & 0 & 2 \\ 1 & -1 & 0 & 3 \\ 1 & -2 & 1 & 2 \end{bmatrix}$	Apply	a
5	Find whether the following equations are consistent if so solve them $x + y + 2z = 4, 2x - y + 3z = 9, 3x - y - z = 2$	Analyze	a
6	Solve the equations using partial pivoting Gauss Elimination method of $2x_1 + x_2 + x_3 = 16, 3x_1 + 2x_2 + 3x_3 = 18, x_1 + 4x_2 + 9x_3 = 16$	Apply	a
7	Diagonalize the matrix $A = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 2 & 1 \\ -4 & 4 & 3 \end{pmatrix}$ and find A^4	Create	c
8	The Eigen Values of Real symmetric matrix are Real.	Analyze	b
9	Reduce the Quadratic form $7x^2 + 6y^2 + 5z^2 - 4xy - 4yz$ to the Canonical form.	Apply	d
10	Reduce the quadratic form $3x^2 + 5y^2 + 3z^2 - 2yz + 2zx - 2xy$ to the canonical form by orthogonal reduction.	Apply	d
UNIT-II			
DIFFERENTIAL CALCULUS METHODS			
1	if $f(x) = \sqrt{x}, g(x) = \frac{1}{\sqrt{x}}$ prove that 'c' of the CMVT is the geometric mean of a and b for any $a > 0, b > 0$	Apply	e
2	find the minimum value of $x^2 + y^2 + z^2$ given $x + y + z = 3a$	Evaluate	g
3	Prove using mean value theorem $ \sin u - \sin v \leq u - v $	Create	e

S. No	Question	Blooms Taxonomy Level	Course Outcome
4	If $u = \frac{yz}{x}, v = \frac{xz}{y}, w = \frac{xy}{z}$ find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$	Apply	f
5	using mean value theorem prove that the function $f(x) = x^2 - 4x + 7$ is increases when $x > 2$ decreasing when $x < 2$	Analyse	e
6	Calculate approximately $\sqrt[3]{245}$ by using LMVT	Apply	e
7	using mean value theorem prove that the function $f(x) = x^2 - 4x + 7$ is increases when $x > 2$ decreasing when $x < 2$	Analyse	f
8	Calculate approximately $\sqrt[3]{245}$ by using LMVT	Analyze	e
9	If $x = u(1-v), y = uv$ prove that $JJ^1 = 1$	Evaluate	e
10	If $x = r\cos\theta, y = r\sin\theta$, find $\frac{\partial(x, y)}{\partial(r, \theta)} \times \frac{\partial(r, \theta)}{\partial(x, y)}$ Also Show that $\frac{\partial(x, y)}{\partial(r, \theta)} \times \frac{\partial(r, \theta)}{\partial(x, y)} = 1$	Apply	F
UNIT-III			
IMPROPER INTEGRATION, MULTIPLE INTEGRATION AND APPLICATIONS			
1	By transforming into polar coordinates Evaluate $\iint \frac{x^2 y^2}{x^2 + y^2} dx dy$ over the annular region between the circles $x^2 + y^2 = a^2$ and $x^2 + y^2 = b^2$ with $b > a$	Create & Analyze	i
2	Evaluate $\iiint_R (x + y + z) dz dy dx$ where R is the region bounded by the planes $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$	Evaluate	j
3	Evaluate $\int_0^1 \int_0^{1-z} \int_0^{1-y-z} xyz dx dy dz$	Evaluate	j
4	Find the volume of the tetrahedron bounded by the plane and the coordinate planes by triple integration	Analyze	j
5	Evaluate $\int_0^{\pi} \int_0^{a(1+\cos\theta)} r^2 \cos\theta dr d\theta$	Evaluate	i
6	Evaluate by changing the order of integration $\int_0^a \int_{\sqrt{ax}}^a \frac{y^2}{\sqrt{y^4 - a^2 x^2}} dy dx$	Evaluate	i
7	Evaluate $\int_0^{\pi/2} \int_0^{a\sin\theta} \int_0^{\frac{a^2-r^2}{2}} rdz dr d\theta$	Evaluate	j
8	Prove That $\frac{\beta(p, q+1)}{q} = \frac{\beta(p+1, q)}{p} = \frac{\beta(p, q)}{p+q}$ where $p > 0, q > 0$	Remember & Evaluate	h

S. No	Question	Blooms Taxonomy Level	Course Outcome
9	Show that $\Gamma(1/2) = \sqrt{\pi}$	Understand	h
10	Prove that $\beta\left(m + \frac{1}{2}, m + \frac{1}{2}\right) = \frac{1}{n} \frac{\Gamma\left(\frac{1}{n}\right)^2}{\Gamma\left(\frac{2}{n}\right)}$	Understand	h
UNIT-IV DIFFERENTIAL EQUATIONS AND APPLICATIONS			
1	A bacterial culture, growing exponentially, increases from 200 to 500 grams in the period from 6 am to 9 am. How many grams will be present at noon?	Understand	k
2	Solve $xdx + ydy = \frac{a^2(xdy - ydx)}{x^2 + y^2}$	Evaluate	k
3	Solve $2xydy - (x^2 - y^2 + 1)dx = 0$	Evaluate	k
4	Find the orthogonal trajectories of the family of curves $x^2 + y^2 = a^2$	Apply	l
5	Solve the D.E $(x+1)\frac{dy}{dx} - y = e^{3x}(x+1)^2$	Evaluate	k
6	Obtain the orthogonal trajectories of the family of curves $r(1 + \cos \theta) = 2a$	Apply	L
7	A particle is executing S.H.M, with amplitude 5 meters time 4 sec.find the time required by the Particle in passing between points which are at distances 4 & 2 meters from the centre of force and are on the same side of it.	Understand	K
8	Solve $(D^2 + 3D + 2)y = 2\cos(2x + 3) + 2e^x + x^2$	Evaluate	K
9	Solve $D^2(D^2 + 4)y = 96x^2 + \sin 2x - k$	Evaluate	k
10	By using method of variation of parameters $(D^2 + 1)y = \cos ecx$	Analyze	K
UNIT-V LAPLACE TRANSFORMS AND ITS APPLICATIONS			
1	Using L.T Evaluate $\int_0^{\infty} \frac{e^{-t} - e^{-2t}}{t} dt$	Apply	m
2	Find $L^{-1}\left\{\frac{s}{(s^2 + 1)(s^2 + 9)(s^2 + 25)}\right\}$	Evaluate	n
3	Find $L\{f(t)\}$ where $f(t) = \begin{cases} t, & \text{if } 0 < t < b \\ 2b - t, & \text{if } b < t < 2b \end{cases}$ of period 2b	Evaluate	m
4	Find $L\left\{\frac{\cos 4t \sin 2t}{t}\right\}$	Evaluate	m
5	Find $L\{g(t)\}$ where $g(t) = \begin{cases} \cos\left(t - \frac{2\pi}{3}\right), & \text{if } t > \frac{2\pi}{3} \\ 0, & \text{if } t < \frac{2\pi}{3} \end{cases}$	Apply	m

S. No	Question	Blooms Taxonomy Level	Course Outcome
6	Find the inverse L.T of $\frac{2S^2 - 6S + 5}{S^3 - 6S^2 + 11S - 6}$	Analyze	n
7	Solve the D.E using L.T, $y'' - 3y' + 2y = 4t + e^{3t}$, $y(0) = y'(0) = 1$	Apply	o
8	Solve the D.E using L.T, $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 2y = 5\sin t$, $y(0) = y'(0) = 0$	Apply	o
9	Find the inverse L.T of $\log\left(\frac{s^2 + 4}{s^2 + 9}\right)$	Analyze	n
10	Use Laplace transforms, solve $(D^2 + 1)x = t \cos 2t$, given $x(0) = x'(0) = 0$	Apply	o

3. Group - III (Analytical Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
UNIT-I THEORY OF MATRICES			
1	If A is n rowed matrix $A = [a_{ij}]$ where $a_{ij} = \begin{bmatrix} i \\ j \end{bmatrix}$, [.] denotes greatest integer then find the value of det A	Understand	a
2	If a=diagonal(1 -1 2) and b=diagonal(2 3 -1) then find 3a+4b	Understand	a
3	If $A = \begin{bmatrix} i & 0 \\ 0 & i \end{bmatrix}$ then find A^{4n}	Understand	a
4	Find the value of k for which matrix $A = \begin{bmatrix} 1 & 0 & -k \\ 0 & 1 & 3 \\ k & 0 & 1 \end{bmatrix}$ is invertible.	Understand	a
5	What is rank of 4x5 matrix	Remember	a
6	If 1,2,3 are eigen value of A then find eigen value of Adj A.	Evaluate	b
7	If $\begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix}$ & $\begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$ are two orthogonal vectors of 3x3 matrix then find third vector	Apply	b
8	If A is nxn matrix, rank is k and normal form is $\begin{bmatrix} I_k & 0 \\ 0 & 0 \end{bmatrix}$ then find order of null matrix below side of I_k	Analyze	a
9	If $A = \begin{bmatrix} 3 & 0 & 0 \\ 5 & 4 & 0 \\ 3 & 6 & 1 \end{bmatrix}$ then express A^3 in terms of A.	Apply	a

S. No	Questions	Blooms Taxonomy Level	Course Outcome
10	Find the rank of quadratic form whose eigen values are 0, 0, 6	Apply	d
UNIT-II DIFFERENTIAL CALCULUS METHODS			
1	When the Jacobian Transformation is used?	Remember	f
2	Find the functional relationship between $u=x+y+z$, $v=xy+yz+zx$, $w=x^2+y^2+z^2$	Understand	f
3	What are critical points?	Remember	g
4	Write the relationship between $u = \frac{x+y}{1-xy}$, $v = \tan^{-1} x + \tan^{-1} y$.	Understand	f
5	Find the stationary values of $x^3 y^2 (1-x-y)$.	Apply	f
6	What are saddle points?	Remember	f
7	What is condition for $f(x, y)$ to have maximum and minimum values at (a, b) ?	Apply	g
8	What is the demerit of Lagrange's method of undetermined multipliers?	Remember	g
9	If $f(x, y) = x y + (x-y)$ then find stationary points.	Apply	g
10	If $u=x^y$ find $\frac{\partial u}{\partial x}$.	Apply	g
UNIT-III IMPROPER INTEGRALS, MULTIPLE INTEGRALS AND ITS APPLICATIONS			
1	Write the relationship between beta and gamma functions.	Understand	h
2	What is the value of $\int_0^{\pi/2} \sin^4 \theta \cos^2 \theta d\theta$ using β -function	Evaluate	h
3	What is the value of $\beta(p+1, q) + \beta(p, q+1)$.	Evaluate	h
4	Find $\beta(m, m)$	Evaluate	h
5	An equivalent iterated integral with order of integration reversed for $\int_0^1 \int_1^{e^x} dy dx$ is	Analyze	i
6	How to find the area of bounded region.	Apply	i
7	How to find the volume of closed surface.	Apply	i
8	What is difference between proper and improper integrals	Understand	i
9	Convert $\int_0^a \int_1^{\sqrt{a^2-x^2}} (x^2 + y^2) dy dx$ to polar co-ordinates.	Apply	i
10	What is the area of $\iint r^3 dr d\theta$ over the region included between the circles $r = \sin\theta, r = 4 \sin\theta$.	Apply	i
UNIT-IV DIFFERENTIAL EQUATIONS			
1	Find the order and degree of $\frac{d^2 y}{dy^2} = \left[y + \left(\frac{dy}{dx} \right)^6 \right]^{1/4}$	Understand	K
2	A spherical rain drop evaporates at a rate proportional to its surface area at any instant t. The differential equation giving the rate of change of the radius (r) of the rain drop is.	Apply	k

S. No	Questions	Blooms Taxonomy Level	Course Outcome
3	If $x \frac{dy}{dx} = x^2 + y - 2, y(1) = 1$ then $y(2)$ is	Apply	k
4	When the differential equation is said to be homogeneous?	Remember	k
5	Mention two applications of higher order differential equations.	Create	k
6	What is general solution of higher order differential equations?	Remember	k
7	what is orthogonal form of the function $f(x, y, \frac{dx}{dy}), f(r, \theta, \frac{dr}{d\theta})$	Remember	l
8	what is general solution of linear differential equation	Remember	k
9	when the Bernoulli's differential equation becomes linear differential equation	Remember	k
10	Give the complementary function for $(D^2+6D+9)y=0$	Apply	k
UNIT-V			
LAPLACE TRANSFORMS			
1	Give example where the Laplace Transforms technique is used	Create	o
2	What are the conditions that the functions has to satisfy to Apply laplace transform	Remember	m
3	Write the convolution theorem	Remember	m
4	What are periodic functions	Remember	m
5	Find $L^{-1} \left\{ \frac{1}{s-a} \right\}$	Apply	o
6	What is Laplace Transform of unit impulse function	Remember	m
7	If $f(0)=0$ find $L \{f'(t)\}$	Apply	m
8	Find the value of $L \{2^t\}$	Evaluate	m
9	When $L^{-1} \left\{ \frac{1}{s^n} \right\}$ is possible	Understand	m
10	If $y''+ y=\sin 3t$ with $y=y'=0$ then find $L\{f(t)\}$	Apply	o